Indicators of Fecal Pollution in the Nation's Waters: All Organisms Are Not Created Equal

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The U.S. EPA's most recent (2000) National Water Quality Inventory lists bacteria among the major causes of impairment to the nation's waters. In Florida (Region 4), as in many other states, warnings are posted on beaches and shellfishing waters are closed due to elevated levels of fecal indicator bacteria such as fecal coliforms, *Escherichia coli* and *Enterococcus* spp. The danger to public health lies not directly in the presence of these bacteria, but in the possibility that human pathogens are co-released in fecal contamination. Originally used as an all-purpose indicator of fecal contamination, deficiencies of the fecal coliform group include high susceptibility to disinfection and high die-off rates in saline (coastal) waters. Thus, the fecal coliform group and its member, *E. coli*, may not be detected when pathogens are present. Alternatively, several studies in tropical/subtropical environments have found that fecal coliforms and *E. coli* may grow in warm, nutrient-rich waters and/or sediments. In this case, their presence might represent a false alarm, since growth of the indicator organisms could provide a false signal of recent, high-level contamination.

The currently recognized indicator organisms are broadly distributed in the feces of animals. This distribution is problematic, because even if one accepts the premise that these microorganisms are indicative of fecal pollution and probable pathogen presence, it is not possible to determine the source of pollution (i.e. cattle farming, sewage, wild animals). A number of methodologies, collectively termed microbial (or bacterial) source tracking (MST), have been developed that attempt to link specific microbial sub-types (strains) with specific host animals. Although some progress has been made in this area over the last decade, much remains to be learned about the survival and ecology of indicator organisms in general, and specific sub-types in particular, when they are released to aquatic environments in fecal pollution.

The goal of this study was to compare the survival/die-off kinetics of various indicator organisms in freshwater and saltwater environments. Furthermore, the differential survival of certain *E. coli* sub-types was assessed by genetic typing (ribotyping). In general, indicator organisms survived longer in sediments than in the water column, suggesting that sediments can serve as a reservoir for indicator organisms. Salinity dramatically affected the survival of the fecal coliforms, but not the enterococci. Differential survival of certain *E. coli* strains was consistently noted, suggesting that some strains within *E. coli* populations are better equipped to deal with the stresses of aquatic environments than others. Thus, not only are different types of indicator organisms affected differently by the stresses they encounter in subtropical, aquatic environments, but within species that were assumed to be homogeneous, sub-populations also exhibit differential survival. The results of this study will impact how states make total maximum daily load assessments, as well as how they regulate recreational and shellfishing water quality.